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FORMATION OF "NEW ZAIBATSU" IN PREWAR JAPAN

—CASE STUDY ON NISSO KONZERN—

By Masahiro SHIMOTANI*

I Present Situation and Problems of the Study on "New Zaibatsu"

In the prewar period of Japanese economy there were 5 corporate groups which were called "New Zaibatsu" or "New Konzerns (Concerns)". They were Nissan, Nitchitsu, Mori, Nisso and Riken groups. The term "New Zaibatsu" was used in contrast with the old "Established Zaibatsu" such as Mitsui, Mitsubishi, Sumitomo and Yasuda. As discussed later, those new Zaibatsu groups had several common features and the most remarkable one of them was in that these groups expanded their influences abruptly in 1930s. It is well-known that Japanese capitalism rapidly proceeded just during 1930s from the quasi-wartime system (starting from Manchuria Incident in 1931) to the wartime system (beginning in Sino-Japanese War, 1937) and developed its munitional industrialization. It is often said that "New Zaibatsu" was those newly developed corporate groups which had increased rapidly their business scales and influences owing to the munitions boom.

Of course, other than these 5 "New Zaibatsu" there were other new corporate groups which made a radical growth during 1930s. Usually, however, the term "New Zaibatsu" seems to be used for the above 5 corporate groups, with a few exceptions. The "common features" of these groups are, other than the abovementioned 1) they made a rapid expansion owing to the munitions boom during 1930s, as follows: 2) each of these groups had a leader with a background of engineer; 3) each of them formed a technology-oriented corporate group based on the munitionrelated industries such as chemical or machine industry; 4) each of them had not its own bank within the group and depended on national banks (such as Kogyo Bank, Chosen Bank and the like) in 1930s; and 5) they had close relations with the military authorities. Some of them had established their bases through the accumulation of capital during the period of unusual boom after World War I and continued to grow radically or advanced strongly into Japanese colonies by forestalling the groups of old "Established Zaibatsu" who were rather cautious to extend their businesses to the heavy and chemical industries. There were other groups of "New Zaibatsu", however, who lost their influences rapidly in confronting the start of "Established Zaibatsu" groups' earnest expansion of businesses after the middle of 1930s.

Thus, the "New Zaibatsu" groups actively took initiative in the Japanese capitalism's industrialization with the heavy and chemical industries which started after World War I,

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and in this respect their style of behavior is understood usually in contrast with that of the "Established Zaibatsu" groups who were cautious to advance into the fields of the heavy and chemical industries by emphasizing primarily the "preservation of Zaibatsu families' property". Since the studies on the history of Japanese economy have recently been focussed on the period between the two world wars (especially, on 1920s and 1930s), the study on "New Zaibatsu" has a quite important meaning in investigating the heavy and chemical industry-oriented industrialization of Japanese economy as one of the major subjects of the studies on the abovementioned period.

As such, the study on "New Zaibatsu" has, in addition to the heritage from some studies in the prewar time, been increased by the works of those younger researchers who have come on the stage during these 10 years, and the actual conditions of the new Zaibatsu groups have been made clear to some extent.[1)]

These studies, however, have rather been focussed to date on Nissan and Nitchitsu Groups among "New Zaibatsu", and almost no postwar study has been made public on Nisso Konzern (Concern) which is the object of this paper. Therefore, the abovementioned common characteristics of "New Konzerns" should be said to have been derived by excessively generalizing the results of studies on Nissan and Nitchitsu or by including some analogies and should be imprecise ones to a great extent.

The main subjects in the research of "New Zaibatsu", of course, consist in trying to carry out a precise fact-finding of the history itself of their formation which has remained unclear to date partly because of limited availability of materials. Especially, the most important subjects would be as follows: [1] the evaluation of their role in the industrialization towards the heavy and chemical industries of Japanese capitalism, based on historical facts; [2] their relations with the munitions industry and military authorities, in other words, with the wartime economy; and [3] the relationship between their functions and the organizations (corporate group structures) employed by them, that is to say, the elucidation of the meaning of "a new existence form of capital" as a corporate group within the framework of an industrial system (so-called "industrial konzern").

These 3 subjects are important not only for elucidating the characteristics of "New Zaibatsu" in contrast with "Established Zaibatsu", but also for making clear the premise to integrate (if possible) those 5 corporate-groups, which have an extremely great variety of different organization structures and business behaviors, into one concept or title as "New Zaibatsu". In the future, the more the studies on individual "New Zaibatsu" groups are developed and individual features of each of them are clarified, the more strongly their "differences", but not "community", will be emphasized inevitably. Under such circumstances, the reasons why they were comprehensively called with one concept or title of "New Zaibatsu" at that time (the middle of 1930s) in spite of their individual

1) For example, the study on Nissan Group by Masaru Udagawa, that on Nitchitsu Group by Masahiro Shimotani, Takeshi Ohshio and Barbara Molony, that on Riken Group by Satoshi Saito and other studies. As the recent works on overview of new Zaibatsu Groups, Kiyoshi Tatematsu "New Zaibatsu", *Systematic Modern History of Japan* (*Taikei Nippon Gendaishi*) edited by Masanori Nakamura, vol. 4; Takeshi Ohshio, "New Konzern", *Socio-economic History* vol. 47, No. 6; and Masaru Udagawa, *History of Showa Era and New Zaibatsu*, 1982, *New Zaibatsu* (*Shinko Zaibatsu*), 1984.

differences should always be born in mind.

As above is the present situation of the studies on "New Zaibatsu". In addition, as a remaining problem one can refer to the following fact. That is the fact that the studies accumulated in the prewar time—the academic heritage constituting the base of present studies—almost ended with the period around 1937 of the history of "New Zaibatsu", and the history of their actual conditions after the period to the end of World War II has almost remained blank up to date. It would be needless to say that the investigations into the concrete facts about "New Zaibatsu" under the wartime conditions (as to how they made a progress or suffered a setback in the wartime economy after appearing on the stage owing to the munitions boom under the quasi-wartime conditions) are quite essential as the finish of the "New Zaibatsu" study, although the limitation in availability of materials may become greater.

II Pre-history of the Formation of Nisso Konzern

Based on the abovementioned situation at present of the historical development of the studies on "New Zaibatsu", this paper will select as its object of study "Nisso Konzern" which has especially small accumulation of studies up to date. It was in 1920 that Nippon Soda Co., Ltd. (Nisso) was established which would constitute the core of the Konzern (Concern), and the key person who led the company's establishment was Yurei Nakano (1887–1965) who was the inventor of the diaphragm process for salt electrolysis (Nakano method).[2)]

As for then Konzern, only its conditions towards the middle of 1930s when it completed the Konzern form have been clarified to some extent, but its history before that time still remains almost unclear. Therefore, this paper will discuss definitely its conditions in the stage before its development to "New Zaibatsu" (a corporate-group), especially focussing on the period after the middle of 1920s, that is, the period when Nippon Soda Co. had advanced the diversification of its businesses or the development of its factories within the frame of one company.

III Plant Development in Nippon Soda

Nippon Soda had only one factory—Nihongi Plant— untill 1925 which continued to occupy a key position in the company during the whole prewar time. After that, following plants were constructed successively by 1935: Toyama, Aizu, Kuroi, Tokyo, Takaoka and Saitama Plant (see Fig. 1). Such a development of plants in rapid succession within a company could be contrasted with the successive establishment of subsidiary corporations—corporate groups making—by the company which was started suddenly after 1935. Each of the abovementioned plants played different roles respectively along the lines of business diversification by the company. In the way of this plant development this paper will see below the characteristics of the business diversification of the

2) As for the conditions in the starting period of Nippon Soda, see Masahiro Shimotani "The Soda Industry in Taisho Era and The Formation of Nippon Soda", *Keizai Ronso*, Vol. 127, No. 2–3.

Figure 1. Plant Development in Nippon Soda Co.

name of plant	location	year & month	main products
Nihongi	Niigata	1920. 6	caustic soda, bleaching powder, chlorine compounds, dyestuffs, hydrogenated oil, chemicals
Toyama	Toyama	1926. 11	sodium, ferroalloy
Aizu	Fukushima	1928. 9	zinc, ferroalloy, cadmium
Kuroi	Niigata	1932. 3	ferroalloy
Tokyo	Tokyo	1933. 12	medicine, bleaching agent
Takaoka	Toyama	1934. 9	caustic soda, bleaching powder, sulfuric acid, aluminum
Saitama	Saitama	1935. 12	nitrocellulose

company and the movement towards the formation of New Zaibatsu.

As can be seen from Fig. 1, the plant development of the company may be classified into the following 2 courses: one of them is the development course by the effective use of chlorine and other by-products from caustic soda (alkaline development): and another is the development course towards the production of galvanized zinc, ferroalloys and the like (metallurgical development). Both of these developments were obviously interrelated with the use of electrocity. The reason why these 2 development courses were combined together especially within an enterprise—Nippon Soda can be found, as described in another paper,[3] in the special conditions at the starting point of the company (the operation of Nippon Galvanized Zinc→Nippon Electric Furnace Industry in parallel with that of the company and the merger of the former in 1926). Each course of development will be discussed in the following.

1. Alkaline Development

(1) Nihongi Plant

Nihongi Plant, starting operation with the establishment of Nippon Soda, was really the company's key factory, which not only played a role of an "experimental factory" for the later plant development (further later, for the development of subsidiary corporations) but also had an overwhelmingly great number of product items compared with other factories. Its product items had rapidly grown from 3 in 1920 to 5 in 1925, 20 in 1930 and 72 in 1935[4]. Of course, such a great variety of the products was a result of the diversified development of processes peculiar to the chemical industry and most products were intermediate and half-finished products.

The diversified development of processes started from the processing, that is, the effective use of the by-product chlorine gas inherent to the electrolytic soda industry. Figure 2 shows the tendency of production and import of caustic soda since 1926, where one can see that import products continued to have a fairly great share in the Japanese market. This was not necessarily because of the deficiency in production capacity of caustic soda itself, but rather because of the limitation in processing capacity of a troublesome by-product—chlorine.[5] The greatest user of chlorine at that time was bleaching

3) *op. cit.*

4) Nippon Soda Co., Ltd., *30 Years History of Nihongi Plant (Draft)*, 1951, p. 130.

Figure 2. (t)

	caustic soda					bleaching powder	
	output			import	export	output	export
	electrolytic	caustification	total				
1926			25,341	36,574	43	33,288	2,643
27			24,094	41,361	54	37,384	2,613
28			28,700	61,741	33	46,325	3,111
29			57,382	42,816	22	50,756	3,140
30	26,539	8,199	34,738	37,589	18	49,471	3,446
31	30,992	17,544	48,536	41,596	11	45,005	3,542
32	37,301	37,815	75,116	28,193	2,511	47,485	2,587
33	47,444	63,509	110,953	12,447	5,116	61,142	3,391
34	64,519	113,252	177,771	9,928	12,282	66,155	4,248
35	92,015	141,273	233,288	19,936	17,497	77,080	6,489
36	116,132	168,867	284,999	11,597	23,430	79,228	8,505
37	131,155	221,876	353,031	27,429	5,514	91,903	6,990

powder which was not easy to export by reason of the difficulty in maintaining quality. Therefore, the industry of bleaching powder always suffered from overproduction, and the continuous curtailed operation of the industry under the agreement by the Association of the Bleaching Powder Industry really reflected that situation. The curtailed operation of the bleaching powder industry directly resulted in the reduced operation of the caustic soda industry. Thus, the effective use of chlorine gas to other products than bleaching powder was urgent necessity for all the electrolytic soda makers.

The makers had been intensively competing with each other to develop effective usages of chlorine which was in fact a "nuisance" in manufacturing caustic soda, and the maker who succeeded in the development could indeed take a leading position in the competition among the soda makers. In this way, users of chlorine had gradually been expanded. Actually, however, the production of bleaching powder, which was only one mass-consumption user of chlorine, was restricted by highly curtailed operation, as above described, and other inorganic usages of chlorine (its demands for inorganic compounds) were limited quatitatively in their nature. Under these circumstances, it was the development of a new way of mass-consumption of chlorine, that is, the development of its organic use that gave a motive for Nisso to make rapid progress.

Before discussing the organic uses of chlorine, let us look here briefly the situation of the bleaching powder industry in those days. Since the bleaching powder industry less suffered from the competition by imported products than the caustic soda industry

5) Chlorine processing was in fact a serious problem for electrolytic soda makers at that time. It is said that bleaching powder or calcium chloride made from chlorine was dumped down as a method of chlorine disposal and that some companies purchased the adjacent lands polluted by the leak of chlorine gas directly as plant sites—from interviews with Messrs. Yoshizo Inaba and Taro Inoue (former officers of Nippon Soda Co.).

where import continued to exert pressure upon domestic production, as described in another paper, the soda makers found an advantage in controling the bleaching powder production as a "buffer for the caustic soda manufactures"[6] and continued high-rate reduction of the bleaching powder production under a cartel (the agreement by the Association of the Bleaching Powder Industry). Although the characteristics of the cartel subtly changed depending on the current aspect of business cycle, it remained unchanged that the manufacturers tried to overcome the depression in the main product —caustic soda by the curtailed operation and price control in the by-product—bleaching powder. However, the decline in exchange rate of yen by the second ban of gold export in 1931 made a relatively positive effect on the business of caustic soda, but did not affect directly that of bleaching powder, demand for which had been sufficed by its domestic production, and the market of the latter grew "rather worse in inverse proportion to that of caustic soda."[7] Thus, in October in 1932, Bleaching Powder Sales Co., Ltd. was established with the capital of 200 thousands yen by the industry as a means of more intensive control.[8]

This cooperative sales company was established partly because that the cartel in the past did not necessarily make sufficient effects, but it was also a countermeasure by the electrolytic soda manufactures against the radical change of market with the second ban of gold export. The reason for such behavior of the soda makers were as follows.

At first, although bleaching powder had been reducing gradually its importance as a "buffer" for caustic soda because of the expansion of effective uses of chlorine other than that for bleaching powder, it still maintained the position of the greatest user of the by-product—chlorine. The symptom of depression in the market of such bleaching powder with the second ban of gold export meant for the electrolytic soda manufacturers a crisis of losing the buffer for soda production. Therefore, the creation of the cooperative sales company seems to have included the implication that the manufacturers intended to transform the cartel by the Association of the Bleaching Powder Industry, which had been constantly a negative one in the past to cover the depression in the business of the main product—caustic soda, into a positive, strong one, making use of the occasion where the positions of caustic soda and bleaching powder were reversed.[9] Secondly, there appeared new movements by old competitors and newcomers: with the second ban of gold export the ammonia-soda-process (a process of caustification of soda ash) industry, which had been stagnant in the past, rapidly recovered and became active again; and side-business soda makers such as artificial-silk companies and others (self-sustaining in soda

6) *Toyo Keizai Shimpo*, July 2nd, 1921, p. 30.

7) *Diamond*, October 11th, 1932, p. 34.

8) As for this cooperative sales company, see The Association of the Soda and Bleaching Power Industries, *History of the Soda Industry in Japan*, Revised and Supplemented Edition, 1938, pp. 425–428; *Toyo Keizai Shimpo*, October 15th, 1932, p. 175; and *Diamond*, October 11th, 1932, p. 34.

9) "The efforts of the electrolytic soda industry may be an illustration of the strongest self-governing cooperation by makers of the same industry. The industry has now (in 1933) following three self-controlling organizations—The Soda and Bleaching Powder Fellowship, The Bleaching Powder Association and Bleaching Powder Sales Co., Ltd., and almost complete control is excercised focussing on the production and sales of bleaching powder", *Toyo Keizai Shimpo*, July 22nd, 1933, p. 27.

supply) were newly coming into the electrolytic soda market. It may be needless to say that the traditional electrolytic soda makers were pressed to take the initiative in creating a far stronger organization of the industry confronting these circumstances. For instance, abovementioned Fig. 2 shows that the caustic soda production by the ammonia soda method (caustification method), which is a mass production process without making by-product chlorine, were growing indeed remarkably (the leading makers of this method were Nippon Soda Industry—NSK, later Tokuyama Soda—and Asahi Glass),[10] and other many new comers from the industries which had been users of soda and bleaching powder in the past were advancing one another into the electrolytic soda industry.

> "The motive that caused the artificial silk industry and other big users of soda to implement self-supporting plans in soda supply was eventually nothing other than the exercise of control power by the electrolytic soda manufacturers.... too excessive raising of the price could be said to have been the decisive cause of the situation. The fact that the ammonia soda industry which is said to be a strong rival of the electrolytic soda industry is in these days more intensively increasing the caustification of soda ash obviously has an implication that the latter is caught by its own trap."[11]

It is needless to say that the traditional electrolytic soda manufacturers were urged under these circumstances not only to further strengthen the bleaching powder cartel but also to increase more actively the effective use of by-product chlorine.

Now, turning again to the topic of organic use of chlorine, it is said "The year of Showa 6th (1931) can be said to have been the year when Nakano (Yurei) has taken the opportunity of a new development of his businesses. For he has begun around this year to advance actively into the fields of organic chemistry, although his businesses have centered on inorganic chemical industries in the past".[12]

The first organic use of chlorine in Nihongi Plant of Nippon Soda was the production of carbon tetrachloride and ethane hexachloride for smoke screen requested by the military authorities on the occasion of the outbreak of the Manchurian Incident. In those days there was no domestic production of these chemicals, and Nakano himself, of course, had not at all approached to their production. "Nevertheless, Nakano took up the order of carbon tetrachloride 10 tons and ethane hexachloride 2 tons as soon as the

10) "If we imagine the day when the factories of ammonia soda method will produce soda ash on a large scale and by the caustification of it the price of caustic soda may be lowered, we could not deny that the profitability of the electrolytic soda industry may be threatened necessarily under such circumstances. For this reason, the Soda and Bleaching Powder Fellowship has already requested with it all energy NSK and Asahi Glass to participate in the fellowship, but both these companies refused flatly the participation and eventually the problem of intensifying the control remains pending". *Toyo Keizai Shimpo*, July 22nd, 1933, p. 28.

11) *Toyo Keizai Shimpo*, April 6th, 1935, p. 49. The reason why the newcomer manufacturers have employed the electrolysis method but not the ammonia method is just in that the electrolysis method production has a characteristic of subsidiary business suitable for small-scale operation (for self-supporting purpose).

12) Society for Publication of Yurei Nakano's Biography, *Biography of Yurei Nakano*, 1967, p. 103.

military authorities requested him to produce them".[13] As the result of such forced taking-up of order, and through "such a forcible attitude as the study of the production and the design and construction of the plant were carried forward in parallel",[14] the delivery of the both chemicals began in 1932, the next year. However, the key product in organic use of chlorine was ethylene glycol described below.

Ethylene glycol was "the beginning of the large-scale organic chlorine industry" and an epoch-making product which brought about later the advent of the petrochemical industry.[15] The study on ethylene glycol in Nihongi Plant was started from April, 1931, and its production project was intended originally to satisfy demands in the private sector with the purpose of mass consumption of chlorine.[16] At that time a similar study had been going on in the Army Science Institute and the Nisso's study was carried forward in a tie-up with it. Ethylene glycol had already been produced abroad by Carbide & Carbon Chemical Company, but the development of such an organic chloride was even in U.S.A. at a stage when the American Society of Electric Chemistry had just begun to pay attention for it as a new prospective field. Therefore, the launching of Nisso in this field was, of course, the earliest one in Japan.

The Manchurian Incident (1931) which broke out in the way of progress of the abovementioned study happened to give an impetus to the research and development of ethylene glycol. For, it was found quite useful as an unfrozen coolant for airplanes (in which water-cooling type engines were used in those days) and the military authorities began to pay attention to it. After having received the order, Nakano completed the plant in September, 1932 by rushing construction works and through experimental operation delivered first products 22 cans (18 l/can) to the army already in January, 1933. Figure 3 shows the variety of organic use products of chlorine around 1935 in Nihongi Plant.

As described above, the radical change of Japanese economy after the Manchurian Incident provided a large market for the industry of chlorine organic use by Nippon Soda and gave a great influence to the course of development of the company. In this context, let us here refer to so-called "instructive order" by the army.[17] The "instructive order" was a system of order in which the military authorities requested a private enterprise to build a plant (in many cases, a pilot plant) of a munition product under development and guaranteed in turn to purchase the products at "a conspicuously high price" within a limited ammount and a limited period of time for the purpose to secure the production of the product corresponding to the situation in the future. This system was intended by the army obviously to cause private enterprises to develop and maintain

13) *op. cit.*, pp. 101–102.

14) *op. cit.*, p. 102.

15) See Katsumi Ohga, "Petrochemical Industry at the Starting Stage", *Chemical Economy*, Dec. 1971. As in those days no ethylene, of course, was produced at all in Japan, the efforts were started with the study for production of ethylene by dehydration of ethyl alcohol. Then, ethylene was compounded with chlorine to produce ethylene glycol through ethylene chlorohydrin.

16) Hearing from Messrs. Seiichi Shoyama and Katsumi Ohga (former officers of Nisso).

17) As follows, hearing from Messrs. Shoyama and Ohga.

Figure 3. Organic Use Products of Chlorine in Nihongi Plant.

products	research starting year	production starting year
carbon tetrachloride	1931	1932
ethane hexachloride	1931	1932
ethylene glycol	1931	1933
ethane dichloride	1931	1933
monochlorobenzene	1933	1935
paradichlorobenzene	1933	1935
orthodichlorobenzene	1933	1935
benzyl chloride	1930	1933
phosgene		1934
dinitrochlorobenzene		1936
chloropicrin		1933
chloroform		1934

Hearing from Mr. Katsumi Ohga.

Figure 4. "Instructive Order" in Nihongi Plant.

products	year	use
7C	1935	material of yperite, poison gas
isoheptane	1937	fuel
isohexane	1937	fuel
triphenylarsine	1938	sneez gas
bromobenzylcyanamide	1940	tear gas

Hearing from Mr. Katsumi Ohga.

Figure 5. Production Capacity and Output of Main Companies. (t)

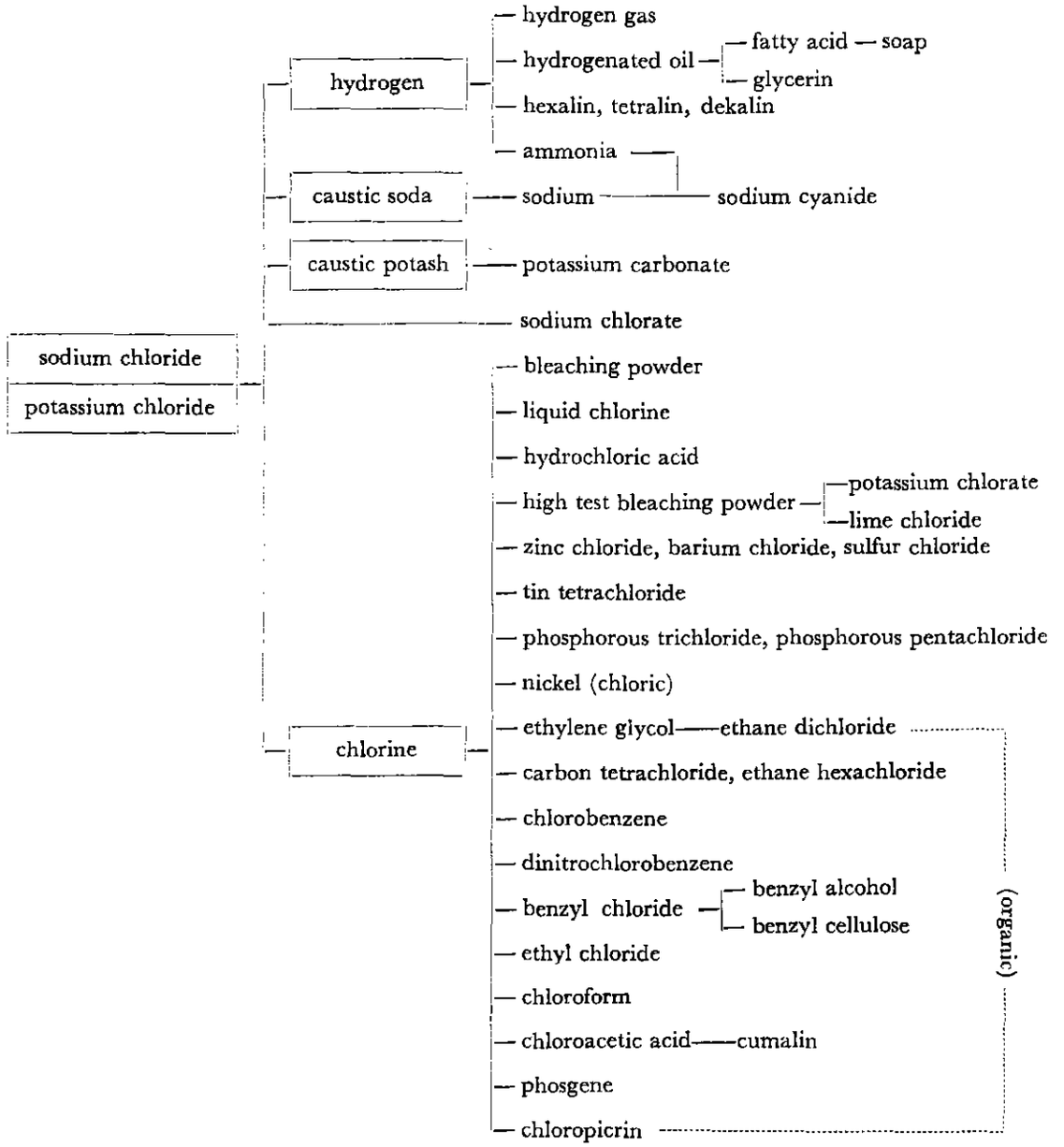
names of companies	Production Capacity (month)		Output in 1934		$\frac{B}{A+B}$
	caustic soda	bleaching powder	bleaching powder (A)	other chlorine compounds (B)	
Nippon Soda	1,000	2,400	9,100	14,500	61.4%
Dainippon Jinzo Hiryo	750	1,700	9,570	5,700	37.3
Osaka Soda	700	1,500	6,230	13,550	68.5
Asahi Denka	650	1,500	6,540	6,400	49.5
Showa Soda	530	1,200	5,810	8,400	59.1
Hokkai Soda	370	850	5,640	4,700	45.5
Nankai Sarashiko	340	800	4,110	2,800	40.5
Rasa Kogyo	340	800	3,740	32	0.8
Hodogaya Soda	180	410	1,440	2,600	64.4
Tokai Soda	180	420	1,590	1,300	45.0

Toyo Keizai Shimpo, April 6th, 1935, pp. 48–49.

production technologies of munitions and to use them fully in an emergency. The "instructive orders" to Nisso's Nihongi Plant is said to have been as shown in Fig. 4.

Thus, by the alkaline development in Nihongi Plant Nisso succeeded to gain the greatest market share of caustic soda in the industry already towards 1925 or 1926, and made a remarkable progress in the effective use (organic and inorganic) of chlorine including the use for bleaching powder, as shown in Fig. 5. The figure shows the conditions in 1934 in which one can find that Nisso occupied the top position not only in the produc-

Figure 6. Product Development in Nihongi Plant by 1937.



Hearing from Mr. Katsumi Ohga. There were several other product-groups such as medicine, dye, etc.

tion capacity of both of caustic soda and bleaching powder among the member companies of the Bleaching Powder Association but also in the production of chlorides (organic and inorganic) other than bleaching powder as expansion of the effective use of chlorine, ranking itself in the top group also in the ratio of the production of these chlorides.

Nihongi Plant, as described above, increased rapidly its product items from 1930. Fig. 6 illustrates graphically the product development by 1937 in the plant. As seen in this figure, since the start of production of caustic soda as the first main product, the alkaline development as the effective use of by-products achieved a systematic expansion up to the formation of a complex of separate industries such as the chlorine industry, hydrogen industry and the like. This may implicate that Nisso had transformed itself from the status of "an enterprise specialized in soda" untill the middle of 1920s to "a electro-chemical enterprise" in 1930s, and can be evaluated as the company "had advanced the first step towards a high-class industry which manufactures chemicals, dyes, medicines and perfumery from the homemade acidic and alkaline materials."[18] The company looked like indeed "a department store in the chemical industry, having quite complex and diversified products".[19] This means, generally speaking, that Nihongi Plant of the company had begun gradually to break through the framework of alkaline development centering on soda products and transform itself into an all-round chemical factory.

However, it must be pointed out here that the soda manufacturer who had carried forward intensively the effective use of chlorine and developed itself into a fine-chemical enterprise was not necessarily Nippon Soda only. Therefore, it is important to examine not only the alkaline development of the company but also its metallurgical development as in the following as the reason why the company only could grow later into one of the "New Zaibatsu" groups.

2. Metallurgical development

As emphasized repeatedly, the starting base on which Nippon Soda could build later a new konzern (concern) was not only the soda industry. That is, the company had started on the basis of the merger of Nippon Electric Furnace Industry (Nippon Galvanized Zinc) (in 1926), so to speak, the "metallurgical development" in parallel with the above-mentioned alkaline development. For example, at first, Toyama Plant constructed as the first sub-plant of the company began to produce iron alloys such as ferrosilicon, ferromanganese and the like in addition to metallic soda, and after that other sub-plants such as Aizu, Kuroi, Takaoka and Iwase were constructed successively in the course of the metallurgical development. The metallurgical development which was carried forward in these several sub-plants formed a contrast with the alkaline development which centered almost in Nihongi Plant as above described. Moreover, the metallurgical development was the preliminary moves for the establishment of Nisso Seiko, one of the 4 pillars (4 big subsidiary companies) which supported later Nisso Konzern and further led indirectly to the establishment of Nisso Mining which was also one of the 4 pillars, as a result of purchasing various mines for self-supporting the materials of metallurgy. Accordingly,

18) *Diamond*, September 11th, 1935, pp. 103–104.

19) Nippon Kogyo Shimbunsha, *Industrial Companies in Modern Times* (*Edition in 1934*), 1934, p. 41.

it must be said that the metallurgical development had great significance for Nippon Soda to grow into New Zaibatsu. It is said: "What has contributed to the performances of this company is not only soda products, but also galvanized zinc, iron alloys and others have done so. Recent radical growths are rather due to the latter products".[20] Let us see briefly individual plant developments in the following.

(1) Toyama Plant

Toyama Plant was the first plant established in addition to Nihongi Plant (it started operation in November, 1926). The purpose of the establishment of this plant was originally to cover the deficiency in electrocity as a result of the alkaline development in Nihongi Plant.[21] In those days Nakano had been carrying forward a self-sustaining power-station plan (in the basin of Yashiro River) for Nihongi Plant and at the same time searching for another source of low-cost electrocity. Then, he found incidentally that Chuetsu Hydroelectric Company had a power-station plan (with output of 13,000 KW) and was seeking for users of electrocity. Upon agreed with the electric company in terms and conditions, he decided immediately to build a factory there (in Yamamuro, the suburb of Toyama City).

The product in the beginning of Toyama Plant was only coarse sodium which was sent initially to Nihongi Plant to be refined there. As described in another paper, metallic soda was the product which had been manufactured by Nakano, before the establishment of Nippon Soda, in Nippon Electric Furnace Industry as a measure for its reconstruction and had been the key product in Nihongi Plant of the latter company. This another Nihongi Plant was merged by Nisso in April, 1926 and integrated into adjacent Nihongi Plant of Nisso, as above referred to. In short, it can be said that Nihongi Plant as such had germs of both of the alkaline development and metallurgical development (with the products of former Nippon Electric Furnace Industry) within it. Therefore, the establishment of Toyama Plant after several months of the abovementioned merger can be said to have meant to separate finally the products of former Nippon Electric Furnace Industry from Nihongi Plant, presumably with the intention to specialize Nihongi Plant in the alkaline development by removing the above products to Toyama Plant from Nihongi Plant where electrocity tended to be deficient and the space was becoming narrower.[22] This intention became further clearer when Toyama Plant began to produce iron alloys (ferrosilicon and ferromanganese) in 1928. Obviously, the production of these iron alloys was the first attempt for Nisso. Its metallurgical technology in general, however, had been accumulated from the time of former Nippon Electric Furnace Industry (further, from the time of its predecessor, Nippon Galvanized Zinc), and particularly there was a technology transfer from Ohdera Refinery (referred to below) which was purchased by

20) *Diamond*, February 11th, 1934, p. 90.

21) As for the history in detail of the establishment of Toyama Plant, see above mentioned *Biography of Yurei Nakano*, pp. 70–80.

22) "In the same (1926) year, Toyama Plant was constructed newly in front of Yamamuro railway station in the suburb of Toyama City, Toyama Prefecture, and the production of metallic sodium which had been conducted in Nihongi Plant in the past was removed to the new factory". Nippon Soda, *Outline of the Company's Businesses (1934)*, 1934, p. 10.

Nisso in 1928. It may be needless to say that the start of production of these iron alloys was intended to use effectively residual electrocity in those days. Thus, the first sub-plant of Nisso, Toyama Plant, was established as the factory for the metallurgical development.

(2) Aizu Plant

The event that determined finally the metallurgical development of Nisso was the establishment of Aizu Plant, the second sub-plant of Nisso. In September, 1928 Nisso purchased Ohdera Refinery, Takada Mining of Takada Trading Co., which had gone bankrupt by the Financial Panic, and restored its zinc electrolysis after having changed the name of the factory to Aizu Plant.[23] It is said that zinc electrolysis was indeed the enterprise which had given Nakano a motive to place the headquarters of his businesses in Nihongi, and therefore it is said: "Nakano had been strongly interested in zinc electrolysis since he had contacted with Nippon Galvanized Zinc in Nihongi".[24] Moreover, the fact that Ohdera Refinery was "for sale" in Aizu where Nakano was born would be a factor which caused him to determine the purchase of it. However, the reason why he started at that time the metallurgical development course decisively needs to be explained. This is just because the price of caustic soda and even that of bleaching powder were pressed to fall in those days as a result of continuous economic crises in the early years of Showa Era and particularly the strong dumping pressure by Brunner Mond Company which had defeated Magadi Company in a desperate struggle (1923). The prices were increasingly falling day after day to the bottom in the second half of 1931.[25] Therefore, it is not unreasonable to assume that Nisso intended to cover the depression in its main business (the alkaline development) by the metallurgical development. Soda enterprises could not have any prospect of recovery if they would continue to specialize only in soda production. As referred to in another paper, Nakano had overcome the postwar depression in the beginning of 1920s by "making changeover of products (to various chlorides) freely and actively responding to the situation and always concentrating efforts just to the most payable merchandise".[26] Against the crises in 1927 to 1928, however, diversification of businesses was required over the framework of the alkaline development.

The effect of the metallurgical development was not necessarily achieved immediately because of the depression at that time, although Nisso had obtained Aizu Plant. In order to overcome the difficulties in the zinc business itself, Aizu Plant should take countermeasures such as: first, reuse of zinc slag accumulated since the time of Takada Mining; second, marketing of concentrated sulfuric acid itself made from the acid used to solve zinc

23) The price of this purchase was 300 thousands yen. In fact "it was said that only machinery and remaining scrap iron were worth 350 thousands yen". *Diamond*, November 21st, 1928, p. 48.

24) Above cited *Biography of Yurei Nakano*, p. 182.

25) See, above cited *History of the Soda Industry in Japan*, Revised and Supplemented Edition, pp. 336–337. "As a trouble in the market in those days one can refer to the dumping of Magadi natural soda (Magadi ash) by Brunner Mond & Co., a British company, in 1927. Indeed, as Magadi soda was dumped at a price lower than the production cost of salt, the manufacturing of caustic soda was struck heavily". Above cited *30 years History of Nihongi Plant (Draft)*, p. 10.

26) Haruki Miyake, *Shinko Zaibatsu Tokuhon (Story of New Konzerns)*, 1937, p. 252.

ores; etc. Especially, the first measure, recycling of slag was indispensable for Nisso. For, Nisso could not obtain Hosokura Mine, which had supplied zinc ores to Aizu Plant, for lack of money at the same time with the acquisition of Aizu Plant, and came to depend on the purchased ores (50 tons monthly) from Budo Mine. The slag processing, which was the first attempt in Japan, was implemented after 1931 on a trial-and-error basis by the introduction and subsequent operation of Weltz furnace. The purchasing cost of the furnace was 300 thousands yen, the same amount as that of Aizu Plant. "The purchase of Weltz furnace was quite a big investment for Nisso at that time and also a life-and-death problem for Aizu Plant."[27] It was only after 1936 with strenuous efforts that the furnace entered at last continuous operation satisfactorily.

For obtaining zinc material, before the purchase of abovementioned Budo Mine acquisitions of self-owned mines were intended and by 1933 such mines as Donsuiwa, Okugawa (both in Fukushima Prefecture), Karatoya (in Yamagata Prefecture), Funauchi and Ikazuchi (both in Aomori Prefecture) had already been bought. By 1934, Budo Mine was acquired and further Iihoh (Niigata Prefecture), Horiuchi (Akita Prefecture) and other mines were purchased one after another. Thus "In 1935, almost 70 percent of crude ores necessary in Aizu Plant was supplied by self-owned mines".[28]

With the abovementioned zinc refining the production of iron alloys occupied an important position in Aizu Plant. Ohdera Refinery of Takada Shokai, the predecessor of Aizu Plant had carried out not only zinc refining by using cheap electrocity supplied by Inawashiro Hydroelectric Power, Tobu Electric Power, Aizu Electric Power and other electric companies, but also the production of iron alloys (ferrosilicon and ferromanganese) by utilizing residual electrocity. Aizu Plant of Nisso succeeded also the iron alloy plant. The reason why the production of iron alloys had been started in Ohdera Refinery involved the problem of quality of electrocity in those days. That is to say, although zinc refining required flat and qualified electrocity supply, there occurred unbalance in supply (namely, residual electrocity) between the raining season and the drought season, and this unbalance was levelled off by using residual electrocity for the production of iron alloys. In this way, galvanized zinc and iron alloys became the key products in Aizu Plant.

(3) Kuroi Plant and Iwase Plant

The above discussed metallurgical development was further expanded to the establishment of Kuroi Plant (in Naoetsu) and Iwase Plant (in the suburb of Toyama City).

Kuroi Plant began to produce iron alloys in 1932. However, the production was conducted in fact in a rented corner of Naoetsu Plant of Shinetsu Nitrogen Fertilizer, and the name of Nisso was not referred to officially in relation to the production. As a part of equipment and almost all employees were provided by Nisso, the plant may be counted substantially as to have been one of the sub-plants of Nisso. All the products of the plant

27) Above cited *Biography of Yurei Nakano*, p. 89. "The amount of 300 thousands yen was same as that paid for obtaining Aizu Plant. Nakano's quite strong interest in Weltz furnace could be imagined by that". *op. cit.*, p. 87.

28) Above cited *Biography of Yurei Nakano*, p. 91.

in 1933 were iron alloys (ferromanganese, ferrosilicon and ferrophosphorus) for steel production. Therefore, the plant was that specialized in iron alloys. After that, as the production had grown and the rented land became narrower, preventing the extension of the plant, Nisso purchased the iron alloy equipment in the rented factory and the adjacent land to remove the plant there, which was started newly in 1939 as Naoetsu Refinery of Nisso.

Iwase plant was established in 1936 and started its production as also a factory specialized in iron alloys where the iron alloy equipment of Toyama Plant was removed. Thereafter, Toyama Plant was specialized in metallic soda untill its closure in 1942. The products of Iwase Plant in 1937 were iron alloys for steel production, metallic magnesium, magnesium carbonate and others (later, abrasives material was added).[29]

(4) Takaoka Plant

The metallurgical development discussed above, especially the development of Aizu Plant after the Manchurian Incident gave a great influence to the direction of growth of Nisso as a whole. This was shown characteristically in its advance into the field of the light metal industry such as the production of aluminum in Takaoka Plant and that of magnesium in Iwase Plant. It is needless to say that these products were demanded greatly as so-called "wartime metals."[30] Now, we will refer here to Takaoka Plant.

Newly established Takaoka Plant was started initially rather as a factory for the alkaline development (its operation began in September, 1934). Initial products were caustic soda (production capacity 240 tons monthly), bleaching powder (same as above, 240 tons), hydrochloric acid (same as above, 400 tons) and others.[31] However, the processing method of caustic soda in Takaoka Plant was mercury method different from diaphragm method invented by Nakano himself and employed in Nihongi Plant, although the both methods were included in the same electrolysis method. The reason why Nakano employed mercury method in Takaoka Plant (or why he employed later ammonia method in Kyushu Soda) is not clear. Some former officers of Nisso have an opinion that Nakano, as an engineer, wanted to try all the production methods of caustic soda. It seems, however, that the reason of employment of mercury method was to overcome the limit of diaphragm method (lower quality, for example, including salt about 1.5%). Caustic soda by the latter method began to be considered as unsuitable in quality for the artificial silk industry which was growing at that time.[32]

Subsequent to the mercury method production of caustic soda, a contact-process plant for sulfuric acid production began to operate in Takaoka in October, 1935. This

29) Nippon Soda, *Outline of Nippon Soda Co. Ltd., (1937)*, 1937, p. 2.

30) "There appeared an apparent direction in the thinking of Nakano towards 1932. Subsequent to the production of lead, zinc and cadmium in Aizu Plant a broad production plan of nonferrous metals in general began to be structured in the thinking of Nakano". Above cited *Biography of Yurei Nakano*, p. 105.

31) "Visits to Factories (13)", *Soda and Chlorine*, Vol. 2, No. 10, 1951, p. 19.

32) In those days, major users of caustic soda were the industries of artificial silk, dye and soap. For example, only the artificial silk industry demanded approximately 50 percent in 1932 and 1933. *Diamond*, January 1st, 1934.

plant was connected with the abovementioned organic use of chlorine in Nihongi Plant and was indispensable especially for the production of the materials such as dye intermediaries.

It must be said, however, that the real development of Takaoka Plant started with the production of aluminum subsequent to the abovementioned acid and alkaline products. Although the study on the production of aluminum was initiated already in 1934 in Nihongi Plant, it was in July, 1937 that Takaoka Plant outputted the first products.[33] The process employed in Takaoka was Bayer's process by which alumina made from bauxite was electrolyzed and aluminum was produced in a continuous operation.[34] The reason why the aluminum plant was located just in Takaoka Plant was that the process required caustic soda of high purity (by mercury method) when alumina was made from bauxite. Thus, Takaoka Plant developed as the base of aluminum production to the second ranked factory in Nisso next to Nihongi Plant, and it is said: "Having concentrated in the production of aluminum since 1938, the factory became a designated factory of the navy and also a supervised factory of the army, and the peak of the production amount of alminum exceeded 10 thousands tons, with 4—5 thousands persons including mobilized students working there".[35]

3. Other Plants

In addition to the above discussed factories for the alkaline and metallurgical developments, there were Tokyo Plant and Saitama Plant which had been constructed by 1935. We will refer to them briefly.

Tokyo Plant began to operate in December, 1933 and produced initially the bleaching agent for flour and other products. It is said that, as the plant was located in Tokyo (Ohji), many offers of various inventions was made from so-called "inventors in the streets" and the like to the factory, and a nickname of "Ubasuteyama (dumping spot) of technologies" was given to it.[36] So, the focus of the production in Tokyo Plant gradually shifted to the finechemical industry. Therefore, "Tokyo Plant was suitable to be called as an institute rather than as a factory, where efforts were made to improve research performances by assigning excellent engineers and without restricting expenses, although the actual production amount was quite small".[37]

Saitama Plant was established in December, 1935 as a factory specialized in the production of cotton nitrate (for explosives, celluloid and lacquer). It was the 7th subplant in Nisso.

33) The alumina plant in January, next the electrode plant, the electrolytic refining plant in July and after that soon the cryolite plant began to operate sequentially in 1937. Hearing from Mr. Toda.

34) Such a continuous operation system for aluminum production within one place was unusual in those days, and it is said that the factory as "an encyclopedic reference factory" was visited very often by people from supervisory agencies, researchers from universities and others. Hearing from Mr. Toda.

35) Above cited *Biography of Yurei Nakano*, p. 112.

36) Hearing from Mr. Shoyama. It is said that the motives of business diversification and Konzern formation by Nisso through the development of subsidiary companies around 1935 included those enterprises which had employed abovementioned "offered" technologies in addition to the enterprises connected technologically with existing subsidiary companies.

37) Above cited *Biography of Yurei Nakano*, p. 107.

Figure 7. Sales of Products in the First Half of 1935.

	thousand yen	%
caustic soda	1,300	21.3
hydrogenated oil	1,200	19.7
ferroalloy	900	14.8
zinc	500	8.2
bleaching powder	200	3.3
chemicals, dyes	2,000	32.8
total	6,100	100.0

As above discussed, Nippon Soda had grown through the alkaline and metallurgical developments. It can be said what was common to the both development courses was the electrocity using (electrochemical) industry aiming at the effective use of cheap electrocity.[38] However, those movements as the diversification of products into quite various fields within Nihongi Plant described above and the advent of the factories with unique products such as Tokyo and Saitama plants meant that Nisso gradually began to further diversify its enterprises by overrunning the framework of the electrochemical industry in the past. For example, in 1935 Nisso's "products manufactured with its own production equipment were of about 100 kinds including industrial chemicals and metals".[39] Figure 7 shows the sales of its products in the first half of 1935. The industrial chemicals in the figure includes, as above referred to, many products other than those derived from both of the alkaline and metallurgical developments (including the products combining them). Thus, transforming itself from a "specialized-in-soda enterprise "to an "electrocity using (electrochemical) enterprise" and at last to a "(comprehensive) chemical enterprise" and continuing, on the other hand, the metallurgical development actively, Nippon Soda had grown to the next stage, the stage of konzern formation. It must be said that the abovementioned expansion of Nisso's industrial bases was an important condition in the pre-stage for its development to a konzern. The trend of business performances of the company in the first half of 1930s is shown in Fig. 8.

IV Business Diversification in Nisso

The subject of this paper is to examine the factory development in Nisso by 1935.

38) "Although the company uses the title of 'Soda Company' in its corporate name, actually the title of 'Electrochemical Industry Company' is rather suitable for it. To such extent, the products are quite various and diversified". *Diamond*, January 11th, 1934, p. 93. "Nippon Soda has a variety of sophisticated enterprises. In the past it has concentrated efforts in the production of soda, now a changeover has been completed substantially. Accordingly, the people concerned are expressing more strongly such opinion that the word "Soda" should be deleted from the name of the company to change it to that suitable for the electrochemical industry". *op. cit.*, February 21st, 1936, p. 130.

39) Nippon Soda, *Outline of the Company's Businesses (1935)*, 1935, p. 4.

Figure 8. Business Performances of Nippon Soda Co. (thousand yen)

year	capital	profit	rate of profit	rate of dividend	sales
1931	3,600	191	19.6%	8.0%	1,350
	3,600	186	19.1	8.0	1,409
1932	3,600	208	19.2	8.0	1,885
	3,600	310	28.6	8.0	2,941
1933	3,600	435	40.1	10.0	3,984
	3,600	703	56.2	12.0	4,442
1934	10,000	807	31.0	12.0	5,495
	10,000	912	35.1	12.0	4,859
1935	10,000	961	40.0	12.0	6,167
	10,000	986	29.0	12.0	6,929

In the end, we will see to some extent the change in the process of business diversification of Nisso around that time, with which the paper will be concluded.

This change was that in the course of advancing the diversification strategy of Yurei Nakano who was the dictatorial leader of Nisso. Nakano himself later called the business diversification of Nisso a "ring-type management method". This meant: "a material creates a product and the product, in turn, becomes a material, as well as a by-product of the product becomes also a material. I call this process a ring-type management method".[40] However, such an intentional and purposeful business-diversification strategy was never given in his mind from the beginning. He said "Frankly speaking, the diversified managements, which is called also "imozuru-type (potato-vine-type) management", was not intended by us from the beginning. What has been obliged to do resulted in such a type of management....it can be said that chlorine has forced my company to expand. In other words, we have made desperate efforts to study how to overcome difficulties and implement countermeasures against them, that has led us inevitably to a diversified management or a imozuru-type management".[41] As he said and as discussed in this and another papers, Nisso was obliged to diversify its businesses "forcibly" and "desperately" for processing by-product chlorine during the period of depression in 1920s. Therefore, the business diversification in Nisso by this time can be said, in a sense, to have been a "resultant diversification".

How the situation changed after the recovery of economy beginning with the second ban of gold export or the outbreak of the Manchurian Incident in 1931? With this respect, there are different opinions. Some people say that Nakano still continued such an approach which may be expressed as a "flickle, weathercock-management" or a "claptrap business-diversification" with his "strong avarice" and "personality devoting himself in business" (for example, an instant purchase of an "offered technology" and forcible taking up of orders), while others evaluate him as to have carried forward the business diversification always by foreseeing technological developments in the future.[42]

40) Yurei Nakano, *Enterprises in the Future and Management in the Future*, p. 127.
41) *op. cit.*, pp. 128–129.
42) Hearing from former officers of Nisso.

The reason why the evaluation varies seems to be in the two-facedness of the personality of Yurei Nakano, that is, the two-facedness in which he was both a progressive, daring businessman and a prominent engineer. We will set aside the discussion about either side of his personality having been superior to the other and only look at here the manner of employment of the engineers who were later given assignments at the front of the diversified development of the company. In this manner we can find a change before and after 1931 and 1932 as a turning point.

It was in 1924, 4 years after the establishment of the company when it began to employ the engineers newly graduated from universities and technical colleges. But initially, the number of employed new engineers was very small and the manner of employment was unsystematic. For example, in each year of 1920s the employed graduates from universities were only 0–2 and those from technical colleges and other special colleges were only 0–3.[43] It was in fact after 1931 or 1932 that the company began to employ engineers regularly and systematically with a particular policy, that is, the policy along the diversified development of the company.[44] After that time, not only the number of employed new engineers increased but also those necessary for the diversified development characteristic to the company (for example, for the organic chemistry, aluminum and metallurgical industries) were employed on scouted. It can be said that such a systematic recruitment of new engineers in a variety of disciplines became possible partly because Nakano began to have in his mind a fixed orientation in the diversification of the company's businesses. Just because of the systematic recruitment of new engineers, the company could expand the range of the business diversification, meet the increasing demands in various chloride products and light metal products and immediately go with the "trend of the time". Indeed, "although there were various reasons for the remarkable growth of Nakano's enterprises, the most substantial reason would be that he could employ a great number of excellent engineers in his enterprises."[45] Attention was paid even in those days to the fact that the company had many engineers of various disciplines and it became one of the significant characteristics of the company. "The company is continuously providing new products in the market by using so many researchers as never found in other similar enterprises....it is the result of their studie sthat the company has a great number of specific products with which no products of other companies are comparable."[46]

Additionally speaking, in precise contrast with the systematic recruitment of engineers as above described Nakano treated all the time the problems of recruitment of so-called "clerks" in a perfunctory manner.[47] For example, the number of clerks (excluding

43) Above cited *Biography of Yurei Nakano*, p. 96.

44) For example, the number of employed graduates (from universities, technical colleges and other special colleges) began to increase from 9 in 1931 to 10, 17 and 26 in 1932, 1933 and 1934 respectively. *op. cit.*, p. 96.

45) *op. cit.*, p. 93. It is said that the number of engineers achieved to 150 in 1935. *Diamond*, September 11th, 1935, p. 104.

46) *Diamond*, February 11th, 1934, p. 91.

47) As described in the following, hearing from Mr. Yoshizo Inaba.

office boys) in the principal office of Nisso towards the end of Taisho when Nisso merged Nippon Electric Furnace was only 3–4, and even in 1930 all clerical work was carried out by only 5–6 clerks. The work included general affairs, accounting, purchase and sales, but precise assignments to each person were not necessarily made in those days. Therefore, there was no specific office-organization table. These clerks "only treated the affairs which had arised". When they were busy, things were left to outside writers to be done, or regularly coming vendors were asked to assist the clerks in doing things. Such a situation continued even after the start of active development in business diversification of the company in 1930s,[48] which reflected typically that Nakano thought so little of "clerks". That is to say, Nakano had a thinking that an enterprise could go on if there were only engineers.

Not only the clerical organization was neglected as above discussed, but also the management for engineers was not organized formally which was only "direct, personal subordination" to Nakano himself.[49] In other words, although Nakano treated engineers best and assigned responsible positions to each new graduate engineer, they had individually only a direct vertical relation (direct subordination) to Nakano himself and even the horizontal relations among engineers were basically those through Nakano in which they competed with each other to carry out the same research theme given by Nakano. As Nakano had every engineer at his complete command through such a "direct subordination", he could personally examine and revise the performance evaluation and salary assessment for individual engineers presented by the factory manager. Thus, the idea of business diversification of Nisso, if it existed indeed, existed only in the brain of Nakano himself. The fact that Nakano could have completely the command of the company through the abovementioned "direct subordination" was one of the important conditions for the company to grow rapidly to New Zaibatsu through vigorous diversification of it businesses. On the other hand, however, the inadequacy in the formation of management organizations of the company as a whole for both clerical and engineering work, as above discussed, became one of the causes of later breakdown of Nisso Konzern.

48) "It was not untill 1936 that the company began to recruit formally new graduates from universities for clerical work". Above cited *Biography of Yurei Nakano*, p. 104.

49) As described in the following, hearing from Mr. Torao Arima, former officer of Nisso.